CLIMATE CHANGE LOWERS PRECIPITATION, PROLONGS DROUGHT IN SOUTHWEST

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By Caitlin Hayes, Cornell Chronicle

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In the late 2010s, when Assistant ProfessorFlavio Lehner worked for the National Center for Atmospheric Research in Boulder, Colorado, water managers often asked him about the drought in the Southwest. Was the low precipitation simply an unlucky draw in the cycle of long-term weather variations? What role did climate change play? Most importantly, was the drought there to stay?

No one had answers, but Lehner began pursuing them.

Now a study by Lehner and his team, published July 9 in Nature Geoscience, shows that climate change and aerosols have indeed led to lower precipitation in the Southwest and made drought inevitable. The research is the first to isolate the variables of human-caused climate change and air pollution to show how they directly affect the region's precipitation; the study predicts that drought conditions will likely continue as the planet warms.

"What we find is that precipitation is more directly influenced by climate change than we previously thought, and precipitation is pretty sensitive to these external influences that are caused by humans," said Lehner, senior author and assistant professor of earth and atmospheric sciences in the College of Agriculture and Life Sciences.

A trend towards lower precipitation in the Southwest started around 1980, with the onset largely attributed to La Nia-like conditions, a climate phenomenon that results in cooler surface temperatures in the tropical Pacific Ocean. The new research shows that even if El Nio-like conditions had prevailed instead, the Southwest would not have experienced a corresponding increase in precipitation.

"In our models, if we see a warming trend in the tropical Pacific, we would expect more precipitation in the Southwestern United States, but that's not the case here," said first-author and doctoral student Yan-Ning Kuo. "On top of the El Nio and La Nia sea surface temperature trends, there's a uniform warming trend because of historical climate change, as well as emissions from anthropogenic aerosols, that both create a certain circulation pattern over the North Pacific. Those two factors prevent the precipitation for the Southwestern U.S. from increasing, even under El Nio-like trends."

Lehner said the results point to a bigger shift in the connection between the weather in the tropical Pacific and in the U.S., due to climate change and aerosols.

"What we call a teleconnection from that region to the Southwestern U.S. is changing systematically," he said, "and these external influences really modulate that relationship, so it doesn't behave exactly how we expect it to behave."

There is some good news. Researchers expect that the concentration of aerosols which includes the emissions from vehicles and industry will drop as China and other countries in East Asia implement policies to improve air quality. But Lehner said warming temperatures may offset those improvements.

"Most experts expect the world as a whole to reduce air pollution, and globally, it's already going down quite quickly. That's good news on the precipitation side," Lehner said. "At the same time, the warming is going to continue as far as we can tell, and that will gradually outweigh those benefits, as a warmer atmosphere tends to be thirstier, gradually drying out the Southwest."

The researchers were able to determine the role of climate change and aerosols by eschewing prevailing climate models that in recent years have not been able to accurately reflect the sea surface temperatures observed in real-time. The team designed their own simulations that allowed them to plug in data from satellites and statistical models to understand the impact of each contributing factor.

Lehner said the research offers new methods for approaching questions about climate change's impact on weather patterns, while also specifically helping water managers and other stakeholders in the Southwest plan for the future.

"In the Southwest, people really depend on what little water there is every drop in the Colorado River, for example, is accounted for through water rights," he said. "I am excited to go back and show the results to people who need them."

Co-authors include Isla R. Simpson, Clara Deser and Adam Phillips from the National Center for Atmospheric Research (NCAR); Matthew Newman from the National Oceanic and Atmospheric Administration (NOAA); Sang-Ik Shin from NOAA and the Cooperative Institute for Research in Environmental Sciences; and Julie M. Arblaster and Spencer Wong from Monash University.

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